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ABSTRACT

The focus of this workshop was to reaffirm the important role that two-year colleges often serve as institutions of choice for minority and other underrepresented student populations. In addition, two-year colleges are particularly well positioned to contribute to pre-college education through scientific literacy programs, teacher enhancement initiatives, and cooperative ventures with state and community agencies. The workshop participants, representing two-year college faculty, administrators, and including K-12 teachers and National Science Foundation (NSF) personnel, were asked to develop the recommendations that serve as the body of this report. The action-oriented recommendations were targeted to specific audiences, including: (1) faculty and discipline-based professional organizations; (2) two-year college presidents and administrators; (3) non-federal agencies, boards, and other funding sources; and (4) NSF and other federal agencies. Comments submitted to NSF by Benjamin S. Shen on the role of two-year colleges in science and technology education are also included. (KR)

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MATCHING ACTIONS AND CHALLENGES

REPORT OF A NATIONAL SCIENCE FOUNDATION WORKSHOP ON SCIENCE, ENGINEERING, AND MATHEMATICS EDUCATION IN TWO-YEAR COLLEGES

Directorate for Education and Human Resources
National Science Foundation
May, 1981

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MATCHING ACTIONS AND CHALLENGES

REPORT OF A NATIONAL SCIENCE FOUNDATION WORKSHOP ON SCIENCE, ENGINEERING, AND MATHEMATICS EDUCATION IN TWO-YEAR COLLEGES

Dale Ewen
David Mertes
Co-Chairs
May 13-14, 1991

Division of Undergraduate Science, Engineering and Mathematics Education
Directorate for Education and Human Resources
National Science Foundation
May, 1991

NATIONAL SCIENCE FOUNDATION
DIRECTORATE FOR EDUCATION AND HUMAN RESOURCES

September 1, 1991

Dr. Walter E. Massey
Director
National Science Foundation
Washington, DC 20550

Dear Walter:

I am pleased to submit the report of the experts who participated in the National Science Foundation Workshop on the state of undergraduate education in Science, Engineering, and Mathematics Education in the Two-Year Colleges. This workshop was developed with the leadership of the Division of Undergraduate Science, Engineering, and Mathematics Education, and with the involvement of all of the divisions of the Directorate for Education and Human Resources.

Held in May 1991, the workshop was composed of 62 members, who represent two-year college faculty and administrators, university representatives, and business/industry representatives. The report and recommendations indicate a serious need for increased attention to undergraduate education in these institutions in order to increase the supply of science, mathematics and engineering personnel, and to improve general science literacy.

Sincerely,

Luther

Luther S. Williams
Assistant Director

LETTER OF TRANSMITTAL

June 14, 1991

Dr. Luther S. Williams, Assistant Director
Directorate for Education and Human Resources
National Science Foundation
Washington, DC 20550

Dear Dr. Williams:

We are pleased to forward to you this report of the proceedings of the National Science Foundation Workshop on Science, Engineering, and Mathematics Education in Two-Year Colleges, held May 13-14, 1991. The focus of this workshop was to reaffirm the important role that two-year colleges play in the education of the nation's undergraduates, especially since community, junior, and technical colleges often serve as institutions of choice for minority and other underrepresented student populations. In addition, two-year colleges are particularly well positioned to contribute to pre-college education through scientific literacy programs, teacher enhancement initiatives, and cooperative ventures with state and community agencies.

The workshop participants, representing two-year college faculty, administrators, and including K-12 teachers and NSF personnel, were well prepared to develop the recommendations that serve as the body of this report. By responding to suggestions made by their professional colleagues and by reviewing the work of previous studies, participants charted a course of action that will, when implemented, improve the quality of science, mathematics, engineering and technology education throughout this country.

With the assistance of the planning committee and NSF staff members, participants received support materials and assignments prior to the workshop date. The five working groups spent two days addressing specific concerns and arriving at consensus regarding each recommendation. These action-oriented recommendations were targeted to specific audiences, including 1) faculty and discipline-based professional organizations, 2) two-year college presidents and administrators, 3) non-federal agencies, boards, and other funding sources, 4) the National Science Foundation and other federal agencies.

The recommendations of the individual groups were presented during a plenary session on the second day, with the following individuals in attendance:

Kasse Andrews-Weller, Department of Energy
Ted Berlincourt, Department of Defense
John Childers, Department of Education
Richard Devon, National Aeronautics and Space Administration
Robert Ellson, House Subcommittee on Science
David Pierce, American Association of Community and Junior Colleges
Benjamin Shen, National Science Board
Robert Watson, National Science Foundation
Peter Yankwich, National Science Foundation

This report has been reviewed by members of the Planning Committee and by the chairs of the five working groups. It is now being submitted to the National Science Foundation in the spirit of cooperation, collaboration, and mutual optimism for the future of science, mathematics, engineering and technology education. We encourage the National Science Foundation, in concert with discipline-based professional organizations and other national associations, to take leadership in responding to these issues by implementing a plan of action that will bring renewed vitality, energy and enthusiasm to our classrooms and laboratories.

Dr. Benjamin S. Shen, a member of the National Science Board, participated fully in the workshop. We greatly appreciate this participation and are including at the conclusion of our reports the comments which he submitted to the National Science Foundation.

On behalf of all the participants of the workshop, we extend to you and to Dr. Robert Watson and Dr. William Haver of the Division of Undergraduate Science, Engineering and Mathematics Education, our deepest appreciation for your support of this endeavor. Your continued commitment to undergraduate programs and your recognition of the significant contribution made by two-year colleges, is applauded by the education community.

Sincerely,

David Mertes
Workshop Co-Chair

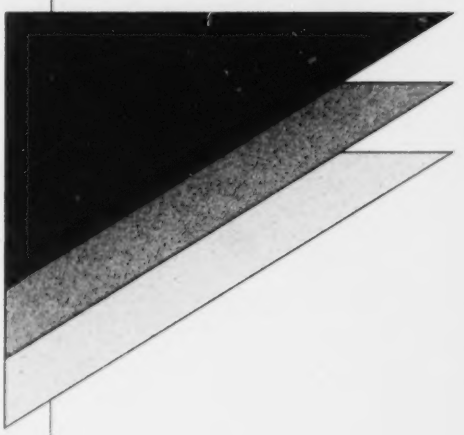
Dale Ewen
Workshop Co-Chair

FOREWORD

In March, 1986, the National Science Board (NSB) released its report *Undergraduate Science, Mathematics and Engineering Education* which described the outcomes of a year-long study conducted by the NSB Task Committee on Undergraduate Science and Engineering Education. This report, which identified serious problem areas in U.S. undergraduate education and made suggestions for remedial action, urged that an effort be made to improve the education of students at two-year colleges, particularly in sciences, mathematics and engineering programs.

In response to the NSB undergraduate education report, the National Science Foundation undertook steps to develop and implement programs that support improvements in undergraduate education. As an additional follow-up to the NSB report, the Foundation convened a two-day workshop on two-year colleges in 1988. Included among participants were two-year college faculty members, administrators, and representatives of business and industry. A report was published by NSF in June, 1989, describing the findings and recommendations of workshop participants. This report was the catalyst for subsequent meetings, inquiries, and surveys conducted by science educators and professional organizations.

In planning for the recent NSF Workshop on Science, Engineering and Mathematics Education in Two-Year Colleges, the reports of these studies served as valuable source material for the identification of topical issues and the development of recommendations. These reports include, but are not limited to, publications issued from various discipline-based associations and from the study conducted for the American Association of Community and Junior Colleges.



In addition to incorporating the recommendations coming forth from these groups into the workshop materials, the members of discipline-based professional organizations were invited to make comments and suggestions for review by workshop participants. It was determined that the workshop must reflect the views of a broad spectrum of two-year college faculty and that conferees must be responsive to the concerns voiced from "the field." In order for the workshop to have significant impact upon educators, agencies and, ultimately, students served, the practical needs — and strengths — of classroom instructors formed the foundation for these proceedings.

The opinions expressed in this report are those of the workshop participants and do not represent NSF policy. Their recommendations are currently under review by NSF.

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EXECUTIVE SUMMARY

The charge given to the sixty participants attending the National Science Foundation Workshop on Science, Engineering, and Mathematics Education in Two-Year Colleges was direct and optimistic. The attendees, representing instructional faculty and administrators from two-year colleges, met with National Science Foundation staff to discuss concerns, to develop strategies for addressing critical issues, and to state specific recommendations for improving the quality of science, mathematics, engineering, and technology education.

Participants in the workshop called for community college faculty to take leadership roles in improving science, mathematics, engineering and technology education at all levels. Rather than recommending sheltered programs targeting community colleges exclusively, they encouraged community college faculty and administrators, NSF, and other national organizations to work together to increase the role of community colleges in improving education in all institutions and at all levels. In particular, they recommended:

- the expansion of NSF's faculty enhancement program to include a comprehensive program designed for faculty who emphasize lower division collegiate education,
- encouragement and support by NSF and other agencies for the development of curricula to meet the needs of increasingly diverse groups of students, and
- concrete steps that all involved could take to make it possible for community college faculty to assume their leadership roles in these activities.

The discipline-based professional associations and other two-year college organizations, most notably the American Association of Community and Junior Colleges, have expended considerable effort in recent years to address the quality of science, mathematics, engineering, and technology education. This activity has provided a body of literature upon which to focus the efforts of this workshop.

THE AUDIENCE

Participants were asked to deliberate within discussion groups and to develop action-oriented recommendations addressed specifically to groups of decision-makers who are positioned to effect change within the national education and business community. **The audiences for whom these recommendations are intended include two-year college faculty, professional organizations, presidents and administrators, state and local funding sources, and the National Science Foundation and other federal agencies.** The recommendations coming forth from workshop participants intentionally and directly focused upon issues that these audiences are capable of addressing. It was clearly acknowledged that effective and long-range improvement in the quality of education must come from the concerted efforts of teaching faculty and administrators through partnerships and cooperative relationships with other educational institutions and organizations, with government agencies, and with the private sector.

THE ISSUES

Five key issues gave structure and substance to the proceedings:

- The critical need for curricular reform and program improvement.
- The critical need to provide professional development and renewal opportunities for faculty.
- The increasingly diverse, and often academically unprepared, student population.
- The need for partnership strategies that would develop and expand linkages with elementary/secondary education.
- The need for active alliances among two-year colleges, private sector business, and industry.

The participants called for immediate attention to the issues that most dramatically affect the quality of instruction in science, engineering, mathematics and technology and, subsequently, the capabilities of the nation's citizens and technical workforce.

THE CONCERNS

The concerns speak specifically to the need:

- for curricular reform,
- for faculty renewal, and
- to attract talented teachers from diverse backgrounds into the professional pipeline.

Support for these initiatives can appropriately be sought through partnerships with other educational agencies and through the combined resources of private industry and state and federal government agencies.

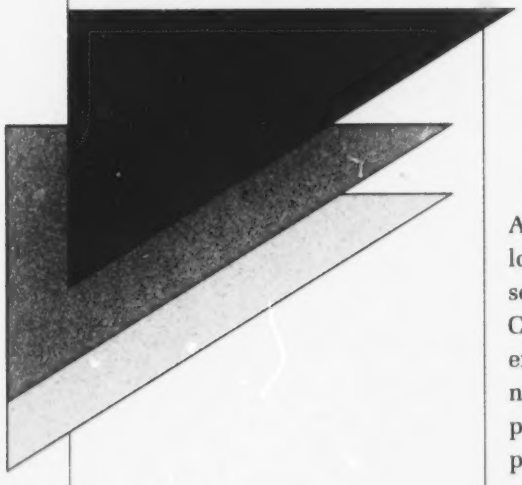
Two-year colleges are ideally positioned to serve as catalysts for educational improvement and to address the national concern for literacy, since they most accurately reflect the diversity of the population. Two-year colleges work closely with pre-college educators as well as with senior institutions through articulation agreements and other cooperative arrangements. The mission of the two-year college specifically provides for accessibility, for comprehensive services, and for quality undergraduate education, making it an effective agent for change.

This workshop concluded that, through collaboration and cooperative efforts, the educational community **can and must** improve the quality and effectiveness of instruction in mathematics, science, engineering, and technology programs. With continued and increased support from the National Science Foundation, and other organizations that share this vision, our nation will remain a leader in the world marketplace and will eagerly meet the technological challenges of the next century.

Introduction

"If one has enough science and mathematics so it's not too frightening, one will graduate with a sense of comfort with science and therefore be a much better presidential candidate, journalist, TV anchorman and citizen."

Leon N. Lederman
Chair, Governor's Science Advisory Committee, State of Illinois
Director Emeritus, Fermi National Accelerator Laboratory
(1990)



American higher education has long faced the challenges of social and cultural leadership. Colleges and universities are expected to respond to the varied needs of an ever-growing populace and to serve as pioneers, to anticipate emerging concerns, and to be prepared with a ready store of solutions. Foremost among those many challenges is the preparation of a scientifically and technologically literate citizenry, which directly impacts productivity in the workplace and the quality of life within a community. The challenge is "part demographic change, part global competition, part accelerating technological change, part worker and adult literacy, part outmoded educational practices and standards — problems exacerbated by the absence of a national strategy to address the challenge" (ACCT/AACJC, 1991).

Integral to the manner in which this nation will determine its economic, political and intellectual health well into the next century is how it prepares that workforce now in the areas of science, mathematics, engineering, and applied technologies.

The renewal of emphasis upon quantitative and analytical skills brings with it great opportunities for community, junior and technical colleges. **The two-year colleges serve as critical links in the "pipeline," educating future scientists and engineers.** They are uniquely positioned to prepare technicians for a competitive global marketplace. Appropriate to their mission, two-year colleges offer opportunities for the training and retraining of the nation's workforce, for the preparation of transfer students from varied

disciplines, and for providing introductory experiences that encourage scientific and technological literacy among youth and lifelong learners.

Along with this substantial responsibility comes the **opportunity — and mandate — for reform**. There are clearly many obstacles in setting forth a national agenda to address these issues. It is generally acknowledged that the higher education community cannot solve the problems of science education single-handedly, but must work in concert with other agencies and with private sector business and industry. The cooperation of all levels of education, along with Federal and state agencies and professional organizations, will be required to systematically address these needs and to compensate for past neglect in the areas of science, mathematics, engineering, and technology education.

The Committee on Education of the American Chemical Society concluded that:

"The interdisciplinary nature of modern science education necessitates the cooperation of the scientific societies to accomplish genuine and lasting improvements in the preparation of the next generation of scientists and engineers." (ACS, 1986)

The National Science Foundation has recognized this need for collaborative efforts and for the necessity of developing cooperative initiatives to improve science, engineering, mathematics, and technology education. They have turned to a capable and receptive agent for educational reform — the nation's two-year colleges. Teaching faculty members were called upon to identify needs and concerns and to develop action strategies to address these issues.

Rather than calling for sheltered programs targeting community colleges exclusively, the recommendations encourage community college faculty and administrators and the NSF and other national organizations to work together to increase the role of community colleges in improving education in all institutions and at all levels.

Community college faculty teach more than 40% of students in higher education and more than one half of first time freshmen, so their participation in these activities is of extreme importance. Indeed, the expertise of community college faculty in personalizing instruction, connecting lessons to context, and creating learning communities among students should be a major contributor to this effort.

The following recommendations reflect the spirit of cooperation and optimism with which this task was undertaken.

RECOMMENDATIONS

A. TO COMMUNITY COLLEGE FACULTY

Two-year college mathematics, science, engineering, and technology faculty should:

- **join and become active participants** in discipline-based local, state, and national professional organizations by assuming leadership roles, writing articles, organizing and leading workshops, and disseminating information about funding sources,
- **work as part of their teacher-scholar activities, through partnerships** with business, industry, and community and economic development organizations to determine and deliver the curricular needs of the workforce,
- **become involved** with local K-12 teachers and students (especially at the elementary level, due to the criticality of maintaining interest in mathematics and science at this age) and to involve two-year college students in mentoring and enrichment programs for pre-college students,
- **aggressively accommodate** the needs of their diverse student populations with the most effective instructional activities, and
- **fully utilize** the student support services that enhance instructional programs, such as academic advising, counseling, tutoring, and financial aid services.

B. TO PROFESSIONAL ORGANIZATIONS

The discipline based organizations occupy a unique position in the educational hierarchy from which to disseminate information, both discipline related as well as pedagogically related. They should:

- assume a leadership role in the initiation and development of **a new vision of the lower division, undergraduate curriculum,**
- design programs to recruit and involve faculty from two-year colleges and other institutions whose primary mission is undergraduate education,
- assist the NSF and other appropriate granting agencies by providing updated lists of interested and qualified reviewers, and
- establish grant committees whose charge is to encourage, lead, and coordinate grant application efforts that reflect the diversity of two-year college students.

Organizations, such as the American Association of Community and Junior Colleges, should serve as a resource for coordination, communication and continuity of efforts that benefit members of discipline-based associations. They should make every effort to support and assist discipline-based faculty-oriented associations in serving their memberships.

C. TO COMMUNITY COLLEGE PRESIDENTS AND ADMINISTRATORS

Two-year college presidents and administrators should implement the recommendation made by the American Association of Community and Junior Colleges,

contained in the report *Building Communities*, that at least 2% of the college operating budget be devoted to staff development. It is further recommended that **discipline-oriented development programs be established for both full- and part-time faculty** in mathematics, science, engineering, and technology.

Two-year college presidents and administrators should make the campus climate conducive to curricular change. Appropriate actions include:

- providing support for resource development,
- creating incentives for faculty to write grant proposals,
- providing logistical support for faculty (space and equipment), and
- providing release time for faculty for professional development.

Another component of improving the campus climate to facilitate curricular change is: to value the professional activity of the faculty, including participation in peer reviews, and service to professional organizations; to fund and provide release time for faculty to attend one discipline-related professional meeting or other development activity each year; and to otherwise encourage the professional activities of faculty.

Two-year college presidents and administrators should use the prestige and support of the NSF to leverage and focus state support for curricular reform of mathematics, science, engineering, and technology.

Two-year college presidents and administrators should facilitate business/industry and community linkages by:

- developing and maintaining their advocacy role in support of partnerships among business, industry, and community organizations as well as among governing boards, administration, and faculty groups, and
- establishing effective networks among community agencies, business and industry, colleges, governments, and related organizations.

Two-year college presidents and administrators should support and encourage faculty involvement in K-12 (with emphasis on K-6) mathematics and science activities by

- providing release time and other incentives, such as travel support, student assistants, and
- appointing a faculty member to serve as liaison to local school districts and to granting agencies.

D.

TO STATES/ NON-FEDERAL AGENCIES BOARDS/ OTHER FUNDING SOURCES

Each state should establish and/or expand their data base and research function to:

- compile and interpret appropriate data for decision-making and management,
- provide better information to the state and to the public, and
- review the status, needs, and objectives of diverse student populations.

Boards, funding agencies, and other sources should provide adequate funding for the infrastructure necessary to enable curricular revision, development, enhancement, and implementation to occur.

Local and state agencies should recognize, nurture, and support the **contributions of community colleges in providing K-12 teacher enhancement activities.**

Local agencies should establish science/mathematics advisory councils that include representatives of community colleges and other educational institutions, community organizations, and business/industry to:

- foster discussion about the educational needs of students,

- open the discourse to diverse voices, and
- encourage broad-based community alliances dedicated to creating innovative educational programs.

E. TO THE NATIONAL SCIENCE FOUNDATION AND OTHER FEDERAL AGENCIES

The NSF and other agencies, as appropriate, should:

- **expand the existing NSF faculty enhancement program** to include a faculty development initiative that reflects the philosophy, structure, special needs, and funding patterns of community colleges and other schools which emphasize lower division collegiate education. In particular, we recommend comprehensive programs involving integrated development of faculty, curriculum, educational strategies, and facilities and equipment.
- **encourage and support the development of curriculum** to meet the needs of increasingly diverse groups of students enrolling in undergraduate mathematics, science, engineering, and technology programs. The curriculum development activities should emphasize the education of technologists and the improvement of the scientific literacy of all students, and not be limited to activities designed for students electing careers in mathematics, science, and engineering. Community college faculty teach more than 40% of students in higher education and more than one half of first time freshmen, so their participation in these activities is of extreme importance. Indeed, the expertise of community college faculty in personalizing instruction, connecting lessons to context, and creating learning communities among students should be a major contributor to this effort.
- **foster networks** among two-year colleges, local communities, and business and industry, in order to:

  (a) encourage projects that provide mathematics and science literacy training for employees in, or about to enter, the workforce, and

  (b) identify alternative funding sources that support community college linkage projects, and
- take steps to **increase the number and improve the quality of proposals** submitted by two-year faculty by:

  (a) reviewing all program announcements to ensure that they include explicit guidelines and review criteria which emphasize areas in which two-year college faculty excel, such as active learning, hands-on experience, development of a community of learners, successful transfer of students at the boundaries of the educational system, service to underrepresented groups, high quality teaching, and appropriateness to the community setting,

  (b) critically reviewing all program announcements to make them more "user friendly"; developing simple guidelines; encouraging pre-proposals,

  (c) increasing the use of two-year college faculty as peer reviewers in order to more adequately reflect the collegiate instructional responsibilities of community colleges,

  (d) developing a resource guidebook for faculty working with K-6 teacher in-service programs, including, but not limited to, synopses of successful programs and a list of names of faculty currently involved with programs who are willing to be contacted,

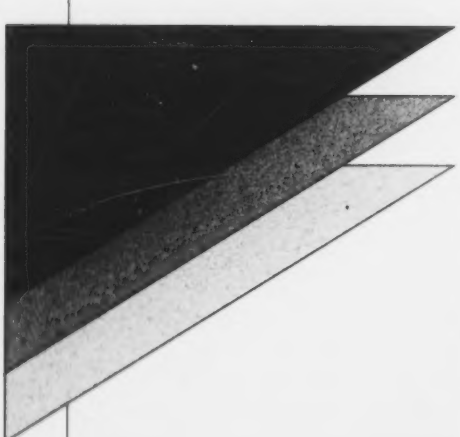
  (e) increasing communication through outreach efforts to two-year college faculty through regional meetings, grant workshops, community college satellite networks, technical workshops, videotapes, and teleconferences,

  (f) clarifying NSF vitae expectations for principal investigators, as submitted with grant proposals, to reflect a broader range of scholarship including teaching, laboratory experience, expository writing, and other forms of presentation, not limited to traditional research, and

(g) providing two-year college professional organizations information regarding numbers of submitted proposals, the number of awards, and the monetary amount of each award by discipline category and by type of institution.

This greater involvement of community college faculty in the programs of NSF's Directorate for Education and Human Resources should be institutionalized by creating a stronger partnership between the two-year colleges and the NSF which would:

- increase the number of NSF staff members with two-year college experience in order to more adequately reflect the collegiate instructional responsibilities of community colleges and
- include at least one two-year college representative on the National Science Board, the Education and Human Resources Advisory Committee, and other NSF advisory committees.



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THE ROLE OF TWO-YEAR COLLEGES IN SCIENCE AND TECHNOLOGY EDUCATION

COMMENTS SUBMITTED TO THE NATIONAL SCIENCE FOUNDATION BY BENJAMIN S. SHEN

Dr. Shen, a member of the National Science Board and its Committee on Education and Human Resources is also the Reese W. Flower professor of astronomy and astrophysics and a former provost of the University of Pennsylvania.

Let me first point out that the opinions I express here are my own and are not necessarily those of the National Science Board.

Your very thoughtful recommendations are all the more valuable since they represent the views of the grassroots faculty and staff of the nation's 1500 two-year community, junior, and technical colleges. There's no doubt that your recommendations will be taken seriously by the National Science Foundation, which solicited them in the first place. In fact, some of the recommended actions are similar to ones the NSF has already taken or is taking, so we are on the same wavelength.

As I said earlier at these meetings, I believe two-year colleges have a critical role to play as the nation strives to improve its global economic competitiveness. More than Ph.D.'s, this country in the coming decades will need people educated to the certificate, associate's degree, and bachelor's degree levels in science, technology, and mathematics. They will be the mainstay of the technically educated workforce who operate our factories, the engineers and technologists who staff our industries, and the math and science teachers steeped in their subject-matter fields who teach in our schools. Some of them will no doubt also go on to become research scientists and engineers.

Two-year colleges play a unique and vital role in at least two ways. First, they supply a large number of technologists who enter the job market directly from the training certificate and associate degree programs. The numbers are impressive. Roughly half of the nation's college freshmen, full and part time, are enrolled in two-year colleges. (Unless otherwise stated, all quantitative data given here are from *Peterson's Guide to Two-Year Colleges - 1991.*) Of the students in public two-year colleges, two-thirds major in *technological* programs of one kind or another. Graduates of such programs are usually in demand. Dr. John Clevenger, professor of chemistry at Truckee Meadows Community College, Reno, Nevada, told me at the meetings that he has trouble keeping students in his chemical technology programs until graduation because they are often hired back with a raise by their waiting employers as soon as they have completed a few needed courses.

Second, two-year colleges feed a large number of qualified, motivated, and successful transfer students to four-year institutions, which they were not academically prepared — or simply could not financially afford — to enter as freshmen. A recent study has shown that, in the state of California, students in four-year institutions who transferred from two-year colleges on the average do as well academically as, and sometimes better than, students who entered the four-year institutions as freshmen (private communication, Ann Reed, Vice Chancellor, California Community Colleges System).

Equally impressive are the largely anecdotal estimates by the engineering deans of four

major state universities across the nation that as much as 40% of their own graduates began as transfer students from feeder two-year colleges (private communication, Woodrow W. Leake, deputy executive director, American Society for Engineering Education.) This is not so surprising when we consider that, nationwide, a large fraction (again some 40%) of all two-year college students transfer to four-year institutions.

By all accounts, most transfer engineering students do as well academically as their non-transfer fellow students. For example, at Cal Poly at San Luis Obispo, which has one of the nation's largest four-year engineering schools, transfer students from two-year colleges are found regularly among recipients of its Outstanding Senior Engineer awards on the basis of their Cal Poly grade-point-average. Unfortunately, reliable quantitative data on the fate of two-year-college graduates are scarce, and there is an obvious need for a good collection of statistical data upon which informed public and private policy can be based.

This is all the more important since many urban or rural two-year community colleges enroll large numbers of disadvantaged Americans, especially disadvantaged minorities. To these students, two-year colleges are their principal gateway to economic opportunity. These colleges are readily accessible because of their essentially open admissions policy for those who have missed out on a solid secondary education, because of their lower tuition charge and the possibility of living inexpensively at home, and, most important, because of their flexibility that allows students to hold down a job on the side. Nationwide, two-thirds of the students enrolled in two-year colleges are part-time, and the vast majority of them have a job on the side. These students are almost guaranteed to possess high motivation for education partly for this reason. Many two-year colleges have had considerable success, through their relatively small classes and effective mentoring programs, in bringing underprepared students to a point where they can do well as juniors and seniors in four-year institutions. The rich and diverse pool of student talent in two-year colleges must not go untapped.

It's well known that, nationwide, a distressingly small and decreasing fraction of the bachelor's degrees awarded are in the physical sciences, mathematics, or engineering. (The biological sciences do slightly better, partly because many pre-meds major in them.) For complex pedagogical, social, and cultural reasons, most undergraduates nowadays avoid majoring in those fields, especially in large universities. A definitive reversal of this trend may not occur for some time, probably not until math and science instruction in secondary schools and colleges can be significantly improved.

In the meantime, it's important that efforts be made to maintain and, if possible, to increase the percentage of two-year college students who pursue technological or scientific majors either at the two-year colleges themselves or later in a four-year institution. Since most two-year colleges are expert at remedial education, they are less dependent on the quality of precollege education than are four-year institutions. From this standpoint, two-year colleges are one of the bright spots on the educational scene, and they ought to be kept that way.

To be sure, I don't think for a moment that two-year colleges are without their share of shortcomings, both serious and trivial, but the point I want to make is that two-year colleges, as a uniquely American institution, can be expected to play a pivotal role in the nation's future economic well-being. The optimal development of this often underestimated national resource for science and technology education leading to the associate and transfer level should be on every policymaker's agenda in both the private and the public sectors.

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TWO-YEAR COLLEGE WORKSHOP
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